Contributions to a Knowledge of the Adventive Flora of New Zealand

No. VIII.—The " Succulent " Element of the Adventive Flora

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Summary

Adventive plant communities of cliff habitats in localities on the east coast of the South Island, New Zealand, are described, these showing a dominance of South African and Canary Islands species.

Fifteen species of succulents are recorded for the first time for the adventive flora of New Zealand, the genera not previously represented being *Aeonium, Aptenia, Drosanthemum, Echeveria, Othonna* and *Sempervivum.*

The true " succulent " element recorded in the adventive flora so far is small and includes *Carpobrotus aequilaterus* (Haw.) N.E. Br., *C. edulis* (L.) Bolus, *Crassula colorata* (Nees) C. H. Ostenf., *C. decumbens* Thunb., *Opuntia monacantha* Haw., and *Sedum acre* L.

A number of other species do occur in the adventive state in New Zealand but have not yet been recorded, it being the purpose of this paper to deal with the group.

In view of the specific habitats in which most of the species occur and the unique characters of the plant communities of which they are members, this treatment is concerned primarily with plant communities, based on habitat and geographical location.

A.—Coastal Cliffs, Canterbury and Otago

Before consideration of these plant communities and their constituent species brief mention can be made of the character of the habitats and the source and type of plants concerned.

In the Christchurch district the cliffs vary from low to several hundred feet in height, and are in the main steep to almost perpendicular, with broad bands of hard rock and narrower bands of softer, " pocketed " material. The plant communities are largely restricted to these latter sites, with the greater proportion of the steep faces uncolonized.

In Otago, some of the cliffs are low, of softer material, in part loessial in nature, with a greater proportion of the area colonized.

With the exception of the cliffs at Lyttelton, at Timaru, and at Port Chalmers, all other sites have a north-east to north-west aspect.

Some of the habitats have been modified to varying degrees over the years by quarrying or by railway or road construction.

Domestic gardens abut the edge of the cliffs in most localities, and it is obvious that the significant species in the different communities have been derived from this source, in part as garden outcasts, in part as garden escapes arising from seed or vegetatively propagated.

It seems that over the years the exacting conditions of the habitats have exercised a natural selection of the species which were grown horticulturally in the localities, and it is these " selected " species which are now significant in these

adventive plant communities. A number of other plants—e.g., *Rochea,* have persisted in adjacent gardens but have shown no tendency to persist outside of cultivation. The communities are now, in effect, living relics of horticultural subjects fashionable with earlier generations of gardeners.

(a) *Redcliffs–Sumner, Canterbury*

Gentler slopes show a shrub layer of *Cytisus proliferus* L. (Canary Islands) and *Sarothamnus scoparius* (L.) Wimmer (Europe), with occasional shrubs of *Albizia lopantha* (Willd.) Benth. (Western Australia), *Cytisus monspessulanus* L. (Southern Europe) and *C. stenopetalus* Christ. (Madeira), a marginal sub-shrubby element of *Chrysanthemum anethifolium* Brouss. (Canary Islands), *C. frutescens* L. (Canary Islands) and **Pelargonium* aff. *inquinans* (L.) Ait. (South Africa). The lowest stratum includes *Cheiranthus cheiri* L. (Europe), *Tetragonia trigyna* B. & S. ex Hook. f. (indigenous) and †*Aptenia cordifolia* (Linn. f.) N.E. Br. (South Africa).

More exposed and steeper slopes have scattered plants and colonies of *Chrysanthemum anethifolium, C. frutescens,* ‡*Echium fastuosum* Jacq. (Canary Islands), *Osteospermum moniliferum* L. (South Africa) and *Pelargonium* aff. *inquinans,* with a scrambling element of *Lathyrus* aff. *tingitanus* L., *Muehlenbeckia complexa* (A. Cunn.) Meissn. (indigenous), †*Pelargonium peltatum* (L.) Ait. (South Africa), *Senecio angulatus* L. (South Africa), *S. mikanioides* Otto (South Africa), and *Tropaeolum majus* L. (South America). The succulent element is represented by †*Aeonium arboreum* (L.) Webb et Benth. (Canary Islands), †*A. ciliatum* (Willd.) Webb et Benth. (Canary Islands), *Aptenia cordifolia,* §*Cotyledon orbiculata* L. (South Africa), †*Drosanthemum floribundum* (Haw.) Schwant. (South Africa), *Mesembryanthemum* sp., †*Othonna capensis* Bailey (South Africa), †*Sedum album* L. (Europe), †*S. praealtum* DC. (Mexico) and †*S. reflexum* L. (Europe).

The steep to perpendicular, often overhanging cliffs, with vegetation confined to "pockets", shelves, fissures, and the prominent basal debris deposit, carries occasional shrubs of *Cytisus stenopetalus, Echium fastuosum, Lycium ferocissimum* Miers (South Africa), *Osteospermum moniliferum,* and *Sarothamnus scoparius,* with a scrambling element of *Muehlenbeckia complexa, Pelargonium* aff. *inquinans,* and *Senecio cineraria* DC. (Western Mediterranean region), and occasional colonies of *Gazania* sp. This particular habitat is dominated by extensive colonies of succulents, which include *Aeonium arboreum, A. ciliatum, Aptenia cordifolia, Carpobrotus edulis, Cotyledon orbiculata,* †*Crassula tetragona* L. (South Africa), *Disphyma australe* (Sol.) J. M. Black (indigenous), *Mesembryanthemum* sp., *Sedum album, S. praealtum, S. reflexum,* and †*Sempervivum* sp.

A seepage fissure on one steep face bears *Apium prostratum* Labill. (indigenous), *Juncus maritimus* Lam. var. *australiensis* Buchen. (indigenous), *Scirpus nodosus* Rottb. ((indigenous), and *Sonchus* sp.

(b) *Lyttelton Harbour Locality, Canterbury*

The vegetation of these cliffs with a southerly or shady aspect differs markedly from that at Redcliffs–Sumner, although only several miles distant. While several species are common to both localities, the succulent element is virtually absent, and a number of different species occur.

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* Spur and pedicels glandular hairy: perhaps identical with, and certainly allied to the plant reported from the North Island by Kirk (1899: 82–3) as *P. zonale* L'Herit.

† Denotes species recorded in this paper as adventive in New Zealand for the first time.

‡ Anon. (1955: 596–7) states ". . . . many succulents have naturalized themselves on cliff faces and in the outcrops, and the blue *Echium fastuosum* grows freely everywhere."

§ It is reported by "Cactophile" (1952: 755) that "Large clumps of this plant [*C. orbiculata*] can be seen growing on the hill at Redcliffs, Christchurch, as well as in many other parts of New Zealand", and also by Anon. (1955: 597) that "At the time of our visit, *Coteledon orbiculata* was in flower everywhere, even in long grass on the hillsides [Sumner], growing as naturally as it must in its native South Africa."

The shrubby element is represented by *Cytisus monspessulanus, C. proliferus, Echium fastuosum, Lavatera assurgentiflora* Kellogg (California), *Lycium ferocissimum, Sarothamnus scoparius,* and *Ulex europaeus* L. (Europe), with a sub-shrubby element of *Chrysanthemum anethifolium* and *C. frutescens.* Three succulents only occur—*Disphyma australe, Mesembryanthemum* sp., and *Sedum praealtum*—and the herbaceous species present include *Agapanthus orientalis* Leighton (South Africa), *Cheiranthus cheiri, Foeniculum vulgare* Mill. (South Europe), *Kentranthus ruber* (L.) DC. (Europe), and *Petroselinum crispum* (Mill.) Airey-Shaw (South Europe).

(c) *Timaru Locality, Canterbury*

Although on a southerly aspect as at Lyttelton, the plant communities are dominated by colonies of several of the species of succulents present.

At the south end of the harbour the low cliffs are covered with extensive colonies of *Carpobrotus edulis, Hedera helix* L. (Eurasia), and *Mesembryanthemum* sp., with *Clematis vitalba* L. (Eurasia) growing in some of the *Hedera* colonies. Scattered shrubs of *Cytisus monspessulanus* and *Sarothamnus scoparius* occur, and plants of *Pelargonium* aff. *inquinans* are scattered through the *Hedera* colonies, but are absent from the *Carpobrotus* and *Mesembryanthemum* colonies. *Antirrhinum majus* L. (Mediterranean region) occurs on bare places and through the colonies of *Mesembryanthemum*..

The cliffs at the north end of the harbour show a smaller range of species, again with extensive colonies of *Carpobrotus edule, Hedera helix, Mesembryanthemum* sp., with scattered plants and smaller colonies of *Pelargonium* aff. *inquinans* and *Sedum praealtum.*

(d) *Oamaru Locality, Otago*

These cliffs have a sunny aspect, are composed of a flaking and eroding loess-like material, and are dissected by vertical fissures or gullies, these usually moist on the bottoms owing to seepage.

The shrubby element is well represented and prominent—*Lavatera arborea* L. (Europe), which occurs as scattered plants and occasional groves, *L. assurgentiflora,* forming short stunted bushy shrubs on the exposed faces and more abundant in its taller, more open form in the moist gullies amongst *Lycium ferocissimum*; this species is found as scattered bushes or small colonies on the exposed faces, with tall dense, virtually impenetrable colonies in the gullies.

The succulent element includes *Aptenia cordifolia,* which under *Lavatera* in the moist gullies occurs in the normal green trailing form, while on the exposed faces lacking other cover it occurs as a distinct tufted, erect (to 12 cm tall) form with reddish-yellow or yellowish-green leaves with reddish blotches—seedlings are abundant. Also found are *Carpobrotus edulis, Disphyma australe, Mesembryanthemum* sp., which form extensive mat-like colonies, and *Sedum acre* L. (Eurasia).

Other species present include *Bromus* sp. (Healy, 1958): *Geranium pilosum* Forst. (indigenous), *Medicago lupulina* L. (Eurasia) with prostrate, much-branched plants scattered over the entire face, *Poa caespitosa* Forst. F. (indigenous), and *Rhagodia nutans* R.Br. (The exact status of this plant is doubtful, and while it falls within *R. nutans* R.Br., it is a markedly different plant from that which occurs in the North Island and north of the South Island. It agrees well with an Australian form of this species, and may possibly be introduced from Australia. It occurs coastally from Oamaru to just south of Kakanui). Small prostrate plants of this latter species occur on the exposed faces but where it is associated with *Lavatera* or *Lycium* it assumes a scrambling habit, and in the moist gullies it scrambles to the tops of the shrubs, with stems finger-thick, and 3 to 4 metres in length.

It can be noted that *Echium fastuosum* was cultivated in gardens adjacent to the cliffs, but there was no evidence (August, 1954) of the species escaping from cultivation.

(e) *Port Chalmers Locality, Otago*

The cliffs are of medium steepness, shattered and fissured, and here, 180 miles further south than Christchurch, several of the same species of succulents occur in extensive colonies.

Shrubs are represented by *Albizia lopantha*, in a grove-like colony near the summit at the north end, and scattered shrubs of *Cytisus monspessulanus*, *C. proliferus*, and *C. stenopetalus*. *Lavatera arborea* forms dense thickets towards the summit adjacent to gardens with scattered plants elsewhere, while its congener *L. assurgentiflora* is less common and not yet thoroughly established. *Lycium ferocissimum* is scattered over the face, as is *Pelargonium* aff. *inquinans*, which is usually associated with individuals or colonies of the shrubby species. *Ulex europaeus* occurs sparingly over the face.

Climbers and scramblers are well represented—*Hedera helix* is abundant, forming extensive colonies on rock faces, *Lathyrus tingitanus* L. (Mediterranean region) and *L.* aff. *tingitanus* are common on debris along the lower parts of the cliffs, while *Pelargonium peltatum* is uncommon, and *Tropaeolum majus* occurs in scattered colonies.

The succulent species present are *Aeonium arboreum* as scattered plants, *Disphyma australe* as small scattered mat-like colonies, *Carpobrotus edulis* with large colonies, and *Mesembryanthemum* sp. the most abundant species. *Sedum praealtum* forms extensive yellowish-green to light-green colonies over the whole area, the colonies many square metres in extent, up to a metre tall and very dense.

Other plants present include *Agapanthus orientalis* with clumps scattered across the north end of the face, *Cheiranthus cheiri* common throughout, *Chrysanthemum anethifolium* and *C. frutescens* scattered over face, and *Vinca major* L. (Europe) in fissures and on rubble, forming extensive colonies.

A small adjacent cliff in the same locality but with a southerly aspect showed a markedly different flora. Shrubs present were *Coprosma* spp. (indigenous), *Cotoneaster simonsii* Baker (India), *Crataegus monogyna* Jacq. (Europe) and *Lycium ferocissimum*. The scrambling element was represented by *Angelica geniculata* (Forst. f.) Hook. f. (indigenous), *Muehlenbeckia complexa* and *Senecio mikanioides*.

(f) *Anderson's Bay, Dunedin, Otago*

These cliffs are lower than at Port Chalmers, with a sloping portion above, and a sheer face below cut with deep moist fissures and occasional pockets or shelves.

Shrubs are not important, and are represented by *Cytisus stenopetalus* with a few old plants and a number of young plants along the sloping upper portion. *Echium fastuosum* is scattered and apparently in process of establishing, *Lavatera arborea* occurs in colonies and as scattered plants, *L. assurgentiflora* is rare, and *Pelargonium* aff. *inquinans* is scattered on the upper sloping area in the vicinity of shrubs.

Succulent plants occupied the greater part of the colonized area; *Aeonium arboreum* was occasional and apparently spreading, *Carpobrotus edulis* formed large mat-like colonies which hung down over the steep faces, *Mesembryanthemum* sp. with scattered colonies, *Tetragonia trigyna* established in fissures, *Sedum praealtum* in scattered colonies, and *S. reflexum* established in fissures and rock shelves.

Other plants noted were *Agapanthus orientalis* in scattered clumps, *Cheiranthus cheiri*, *Chrysanthemum* sp., *Myosotis sylvatica* Ehrh. (Europe) in the fissures under

shelter of other plants, and scattered plants of *Iberis umbellata* L. (Mediterranean region).

B.—Distribution of Species and Citation of Specimens

This section of the paper discusses species of succulents occurring in habits other than the coastal cliffs and species mentioned earlier from coastal cliffs but which occur in other habitats, and lists voucher specimens deposited in the herbarium of the Botany Division, D.S.I.R., Christchurch. Unless stated otherwise, the writer was responsible for observations and collection of specimens.

1. †*Aeonium arboreum* (L.) Webb et Berth. (Crassulaceae). Anderson's Bay, Dunedin, *A. J. Healy & K. W. Allison,* 1954 (83283).

2. †*A. ciliatum* (Willd.) Webb et Berth. (Crassulaceae). Sumner, Christchurch, 1954 (88956, 91554).

3. †*Aptenia cordifolia* (Linn. f.) N.E. Br. (Ficoidaceae). Roadside banks, often under *Sarothamnus scoparius,* Thorndon, Wellington 1953 (85716); Redcliffs, Christchurch, 1954 (88959); normal scrambling form, Oamaru, 1954 (91425); erect, tufted form, Oamaru, 1954 (88470, 91424).

4. *Cotyledon orbiculata* L. (Crassulaceae). Additional to its occurrence in the Sumner–Redcliffs locality, this species was observed (May, 1941) to be well established on steep, eroded mudstone cliffs along the north bank of the lower Waipara River, North Canterbury; Sumner, *H. H. Allan* 1935 (17395); Redcliffs–Sumner, 1954 (83276).

5. †*Crassula multicava* Lem. (syn., *C. quadrifida* Baker) (Crassulaceae). Established on north-west aspect only of a deep cutting, Wadestown, Wellington, a garden escape from sections above the cutting, *C .M. Smith,* 1957 (98660).

6. †*Crassula tetragona* L. (Crassulaceae) Sumner 1954 (91408).

7. †*Drosanthemum floribundum* (Haw.) Schwant. (Ficoidaceae). Blowhole Island, Tauranga, *M. E. Gillham,* 1957 (98669); Sumner, Christchurch, 1954 (91494).

8. †*Echeveria secunda* Booth (Crassulaceae). Occasional as a persistent garden outcast on dry rocky places: near Diamond Harbour, Lyttelton, 1955 (89537); Birdling's Flat, Banks Peninsula, *R. Mason,* 1954 (88662).

9. †*Mesembryanthemum* sp. (Ficoidaceae). This species occurs in all habitats discussed in the preceding section of the paper, and comes close to *M. chilensis* Mol., but its identity cannot be determined with certainty; Oamaru, 1954 (91509).

10. †*Mesembryanthemum* sp. (Ficoidaceae). Characterized by the papillose leaves and whitish flowers, this species occurs as a garden escape about banks and road cuttings, Timaru, *C. M. Smith,* 1957.

11. †*Othonna capensis* Bailey (Compositae). Sumner, Christchurch, 1956 (98050).

12. †*Sedum album* L. (Crassulaceae). This species has been found in a number of South Island localities, and it is probably much more widespread than the following distribution would indicate. It appears to have economic significance in several localities as a weed of ballast along railway tracks; roadside, base of coastal cliffs, Scarborough, Christchurch, 1955 (89495); railway ballast and embankments, Kowhai Bush, Canterbury, *H. Talbot,* 1954 (89496); railway ballast, Rolleston, 1956 (98627); railway ballast, Rakaia, 1956; rocky faces, near Alexandra, 1957 (98606); with *Pellaea falcata* and *Arenaria serpyllifolia* L. on rocky faces, Teviot River, near Roxburgh, 1957 (98522); crevices of rock walls about cattle-trucking yards, and with *Arabidopsis thaliana* (L.) Heynh. on railway ballast,

Palmerston, 1957 (98605); footpaths, Roslyn, Dunedin, *K. W. Allison,* 1955 (89497).

13. †*Sedum dasyphyllum* L. (Crassulaceae). Established coastally along railway embankments with *S. acre* L. and *S. reflexum* L., Oamaru, 1957 (98484).

14. †*S. praealtum* DC. (Crassulaceae). Noted in many localities in both islands, often forming extensive colonies on roadside banks, about cliffs, and adjacent to rubbish dumps; Whakarongo–Bunnythorpe locality, Manawatu, 1953 (82654); Terrace End, near Palmerston North, 1953 (82655); Sumner, Christchurch, 1954 (51794); Price's Valley, Banks Peninsula, 1955 (98661); Anderson's Bay, Dunedin, *K. W. Allison,* 1955 (83281).

15. †*Sedum reflexum* L. (Crassulaceae). McCormack's Bay, Christchurch, 1955 (89505); Coastal railway embankments, Oamaru, 1957 (91566); Anderson's Bay, Dunedin, 1954 (83269); abundantly established in rocky places about Alexandra, 1957 (91562).

16. †*Sempervivum* sp. (Crassulaceae). Sumner, Christchurch, 1954 (89524).

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